AMENDMENTS

Please amend the application as indicated hereafter.

In the Claims

Please amend the claims as indicated below. The language being added is underlined ("___") and the language being deleted contains strikethrough ("—"):

1 – 32. (Canceled)

33. (New) A transmitter, comprising:

a pulse amplitude modulation (PAM) transmitter configured to transmit a point on a signal space constellation, the point representing at least one word;

a trellis encoder associated with the PAM transmitter configured to generate a convolutional code based upon at least one bit of each word;

a fractional encoder associated with the PAM transmitter, the fractional encoder configured to encode a non-integer number of bits for each word to produce an output symbol; and

a constellation encoder configured to map the point on the signal space constellation based upon the output symbol and the convolutional code, the sign of the point being selected by the convolutional code to avoid a bias in positive or negative levels.

34. (New) The transmitter of claim 33, wherein the fractional encoder is configured to collect an integer number of bits S*K, over a frame comprising several symbol periods S, and convert the S*K bits of the frame into S integers, each of arithmetic base M, where M corresponds to a plurality of PAM signal levels, said PAM signal levels increasing in direct proportion to the values of the S integers.

35. (New) The transmitter of claim 33, further including a non-fractional encoder associated with the PAM transmitter;

wherein the constellation encoder is configured to map the point based on the same convolutional code generated by the trellis encoder when using the non-fractional encoder while avoiding a bias in the positive or negative level.

36. (New) The transmitter of claim 33, wherein the trellis encoder generates the convolutional code based upon at least one bit of each word independent of the remaining bits of each word.

37. (New) The transmitter of claim 33, wherein the at least one bit of each word used to generate the convolutional code bypasses the fractional encoder.

38. (New) The transmitter of claim 33, wherein the trellis encoder is a feed-forward non-systematic convolutional encoder.

39. (New) The transmitter of claim 33, further including a PAM encoder table in communication with the constellation encoder;

wherein the constellation encoder is configured to encode the point based upon the PAM encoder table.

40. (New) The transmitter of claim 33, further including a fractional encoder table in communication with the fractional encoder;

wherein the fractional encoder is configured to encode the output symbol based on the fractional encoder table.

41. (New) The transmitter of claim 33, wherein the signal space constellation comprises N signal levels, the output symbol is represented by C(m), and the level of the point generated by said constellation encoder is selected by the convolutional code from:

$-(4C(m)+1)/N$ or $-(4C(m)+3)/N$ for negative levels;

and from:

$(4C(m)+1)/N$ or $(4C(m)+3)/N$ for positive levels.

42. (New) The transmitter of claim 33, further comprising:

a receiver; and

a fractional decoder associated with the receiver configured to decode a received symbol into a non-integer number of bits.

43. (New) The transmitter of claim 33, wherein the fractional encoder is a modulus converter.

44. (New) The transmitter of claim 33, wherein the fractional encoder is configured to collect an integer number of bits S*K, over a frame comprising several symbol periods S, and is configured to encode the frame of S*K bits for transmission at a fractional bit rate of K bits per symbol.

45. (New) The transmitter of claim 44, wherein the fractional encoder is configured to convert the S*K bits of the frame into S integers, each of arithmetic base M, where M corresponds to a plurality of PAM signal levels.

46. (New) A method for encoding fractional bit rates using pulse amplitude modulation (PAM), the method comprising the steps of:

using a PAM modulator to generate a point on an signal space constellation, the point representing at least one word;

generating a convolutional code based upon at least one bit of each word;

encoding a non-integer number of bits for each word to produce an output symbol; and

mapping the point on the signal space constellation based upon the output symbol and the convolutional code, the sign of the point being selected by the convolutional code to avoid a bias in positive or negative levels.

47. (New) The method of claim 46, further including:

collecting an integer number of bits S*K, over a frame comprising several symbol periods S, and converting the S*K bits of the frame into S integers, each of arithmetic base M, where M corresponds to a plurality of PAM signal levels, said PAM signal levels increasing in direct proportion to the values of the S integers.

48. (New) The method of claim 46, further including:

mapping the point based on the same convolutional code generated by the trellis encoder when using a non-fractional encoder, while avoiding a bias in the positive or negative level.

49. (New) The method of claim 46, wherein the step of generating a convolutional code based upon at least one bit of each word further comprises generating the convolutional code independent of the remaining bits of each word.

50. (New) The method of claim 46, wherein the step of mapping the point on the signal space constellation further includes encoding the point based upon a PAM encoder table.

51. (New) The method of claim 46, wherein the step of encoding a non-integer number of bits for each word to produce the output symbol further includes encoding the output symbol based on a fractional encoder table.

52. (New) The method of claim 46, wherein the signal space constellation comprises N signal levels, the output symbol is represented by C(m), and the step of mapping the point on the signal space constellation further includes:

generating the level of the point, the level selected by the convolutional code from:

-(4C(m)+1)/N or -(4C(m)+3)/N for negative levels;

and from:

(4C(m)+1)/N or (4C(m)+3)/N for positive levels.

53. (New) The method of claim 46, further comprising:

decoding a received symbol into a non-integer number of bits.

54. (New) The method of claim 46, wherein the encoding step includes modulus conversion.

55. (New) The method of claim 46, further comprising the steps of:

collecting an integer number of bits S*K, over a frame comprising several symbol periods S; and

encoding the frame of S*K bits for transmission at a fractional bit rate of K bits per symbol.

56. (New) The method of claim 55, further comprising the step of converting the S*K bits of the frame into S integers, each of arithmetic base M, where M corresponds to a plurality of PAM signal levels.

57. (New) A transmitter, comprising:

means for using a PAM modulator to generate a point on a signal space constellation, the point representing at least one word;

means for generating a convolutional code based upon at least one bit of each word;

means for encoding a non-integer number of bits for each word to produce an output symbol; and

means for mapping the point on the signal space constellation based upon the output symbol and the convolutional code, the sign of the point being selected by the convolutional code to avoid a bias in positive or negative levels.

58. (New) The transmitter of claim 57, further including:

means for collecting an integer number of bits S*K, over a frame comprising several symbol periods S; and

means for converting the S*K bits of the frame into S integers, each of arithmetic base M, where M corresponds to a plurality of PAM signal levels, said PAM signal levels increasing in direct proportion to the values of the S integers.

59. (New) The transmitter of claim 57, further including:

means for mapping the point based on the same convolutional code generated by the trellis encoder when using a non-fractional encoder, while avoiding a bias in the positive or negative level.

60. (New) The transmitter of claim 57, wherein the means for generating the convolutional code based upon at least one bit of each word includes means for generating the convolutional code independent of the remaining bits of each word.

61. (New) The transmitter of claim 57, wherein the means for mapping the point on the signal space constellation further includes means for encoding the point based upon a PAM encoder table.

62. (New) The transmitter of claim 57, wherein the means for encoding a non-integer number of bits for each word to produce the output symbol further includes means for encoding the output symbol based on an encoder table.

63. (New) The transmitter of claim 57, wherein the signal space constellation comprises N signal levels, the output symbol is represented by C(m), and the means for mapping the point on the signal space constellation further includes:

means for generating the level of the point, the level selected by the convolutional code from:

-(4C(m)+1)/N or -(4C(m)+3)/N for negative levels;

and from:

(4C(m)+1)/N or (4C(m)+3)/N for positive levels.

64. (New) The transmitter of claim 57, further comprising:

means for receiving a symbol; and

means for decoding the received symbol into a non-integer number of bits.

65. (New) The transmitter of claim 57, wherein the encoding means includes modulus conversion means.